Offshore Wind- the Next Frontier?

Or

From the Futuristic to the Future

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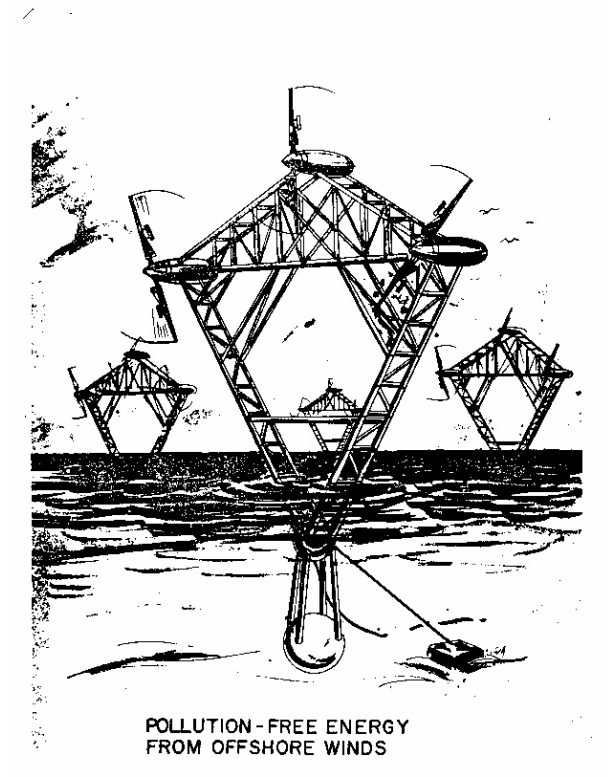
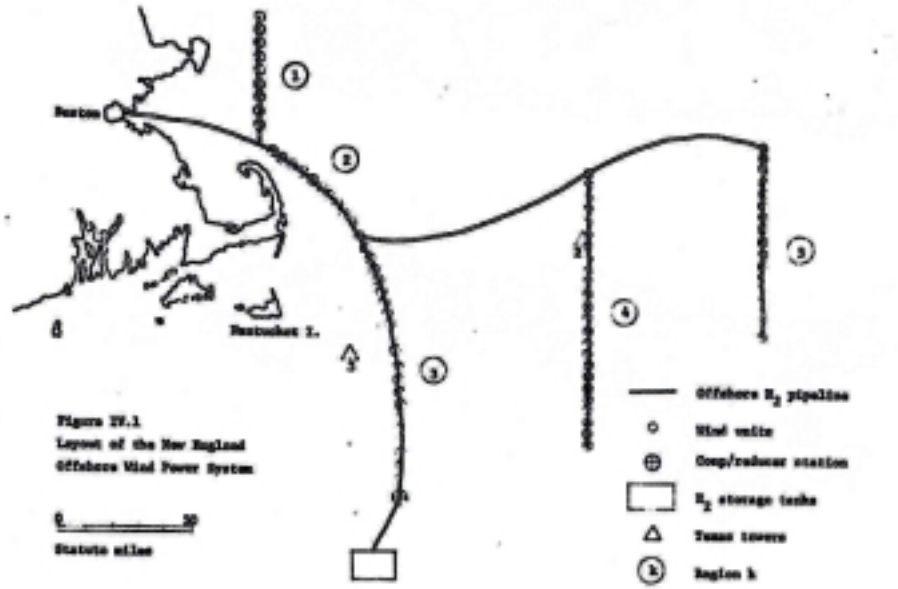
J. F. Manwell, Ph. D.
Director, Renewable Energy Research Laboratory
Dept. of Mechanical and Industrial Engineering
Univ. of Mass., Amherst, MA

Early Conceptual Designs for Offshore Wind in New England

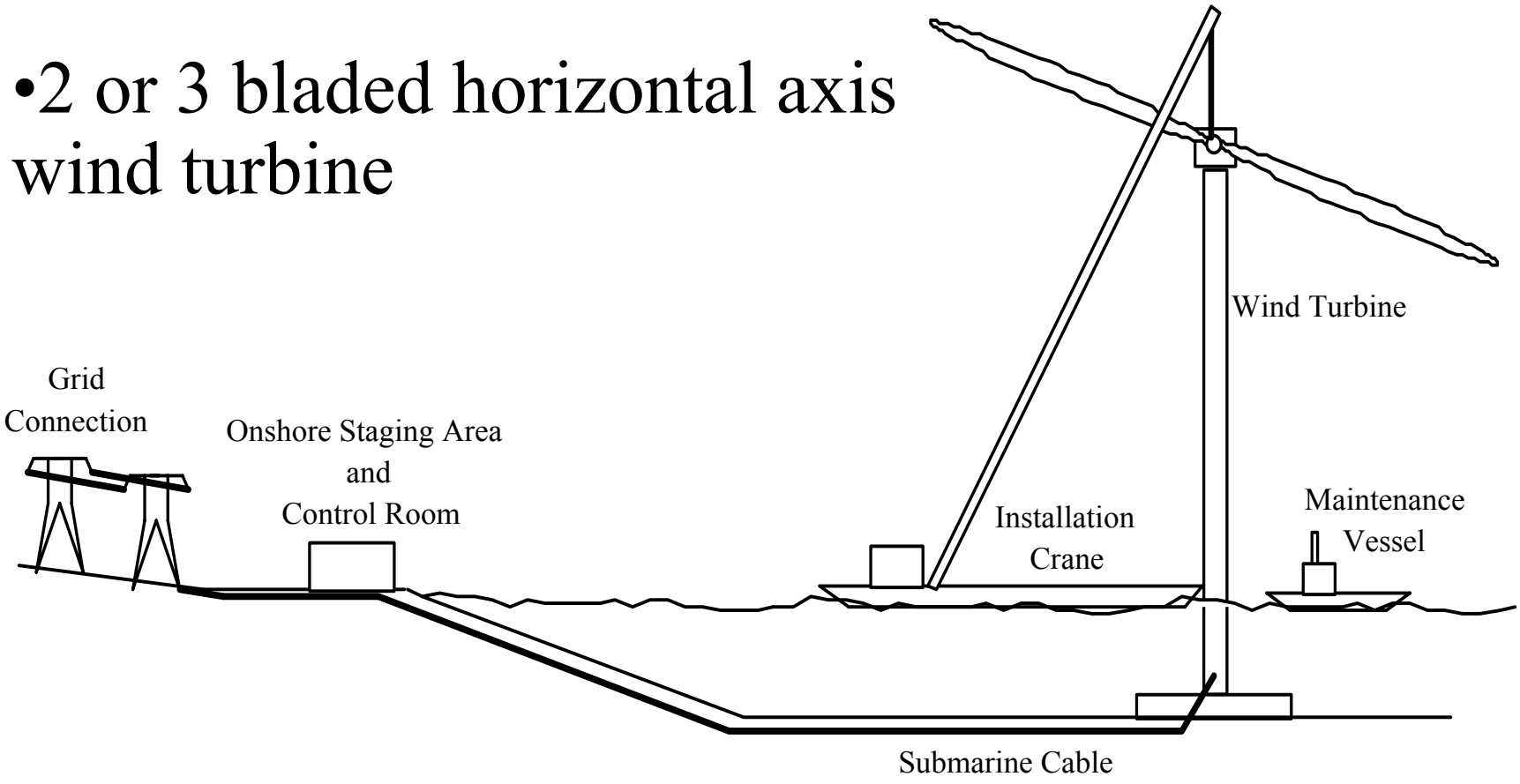




Wind Turbine/ Spar Buoy; Hydrogen Production/Transmission
(Heronemus, UMass, 1973)

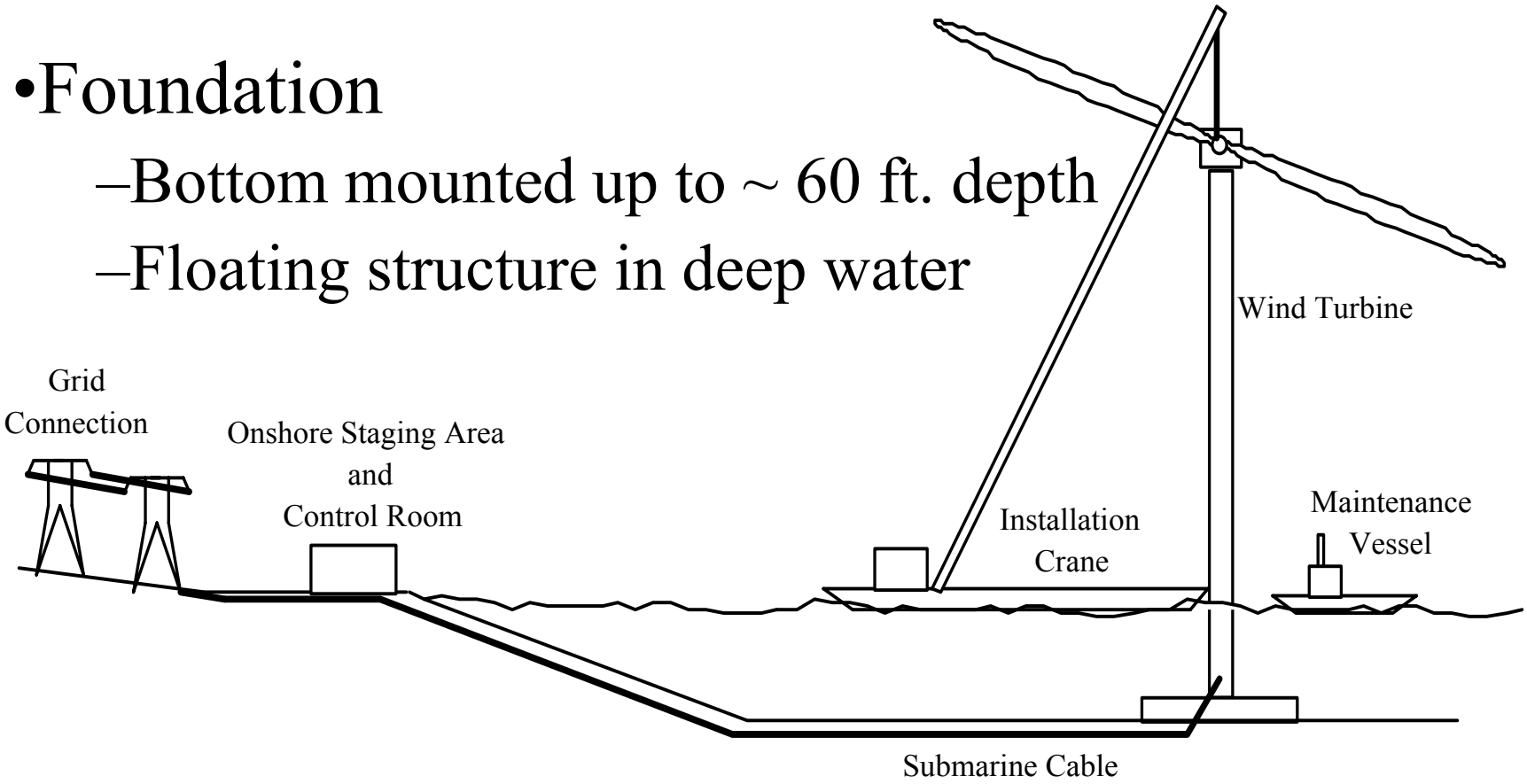
Conceptual Design of Typical Offshore Wind Plant

- 2 or 3 bladed horizontal axis wind turbine



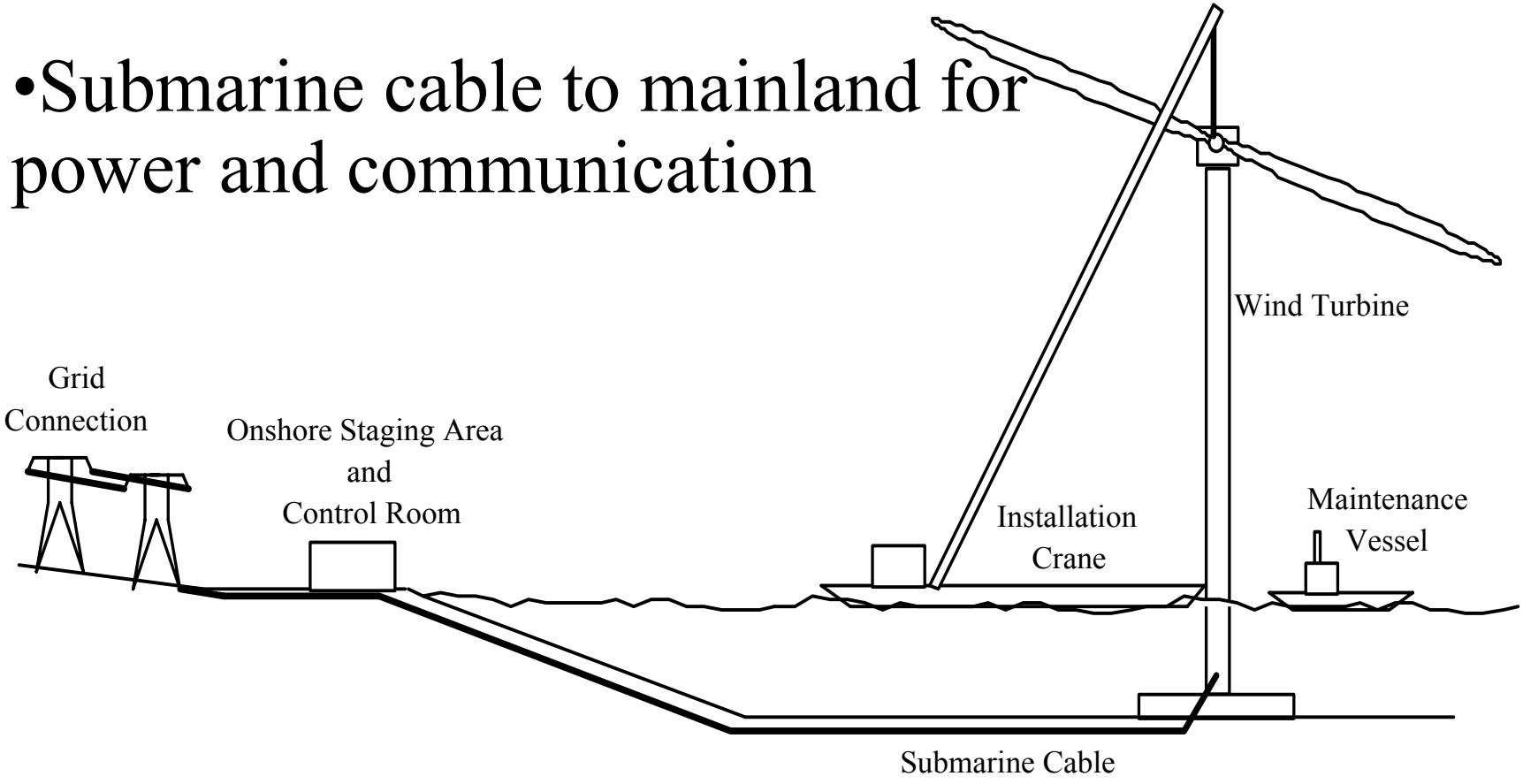
Conceptual Design of Typical Offshore Wind Plant

- Foundation
  - –Bottom mounted up to ~ 60 ft. depth
  - –Floating structure in deep water



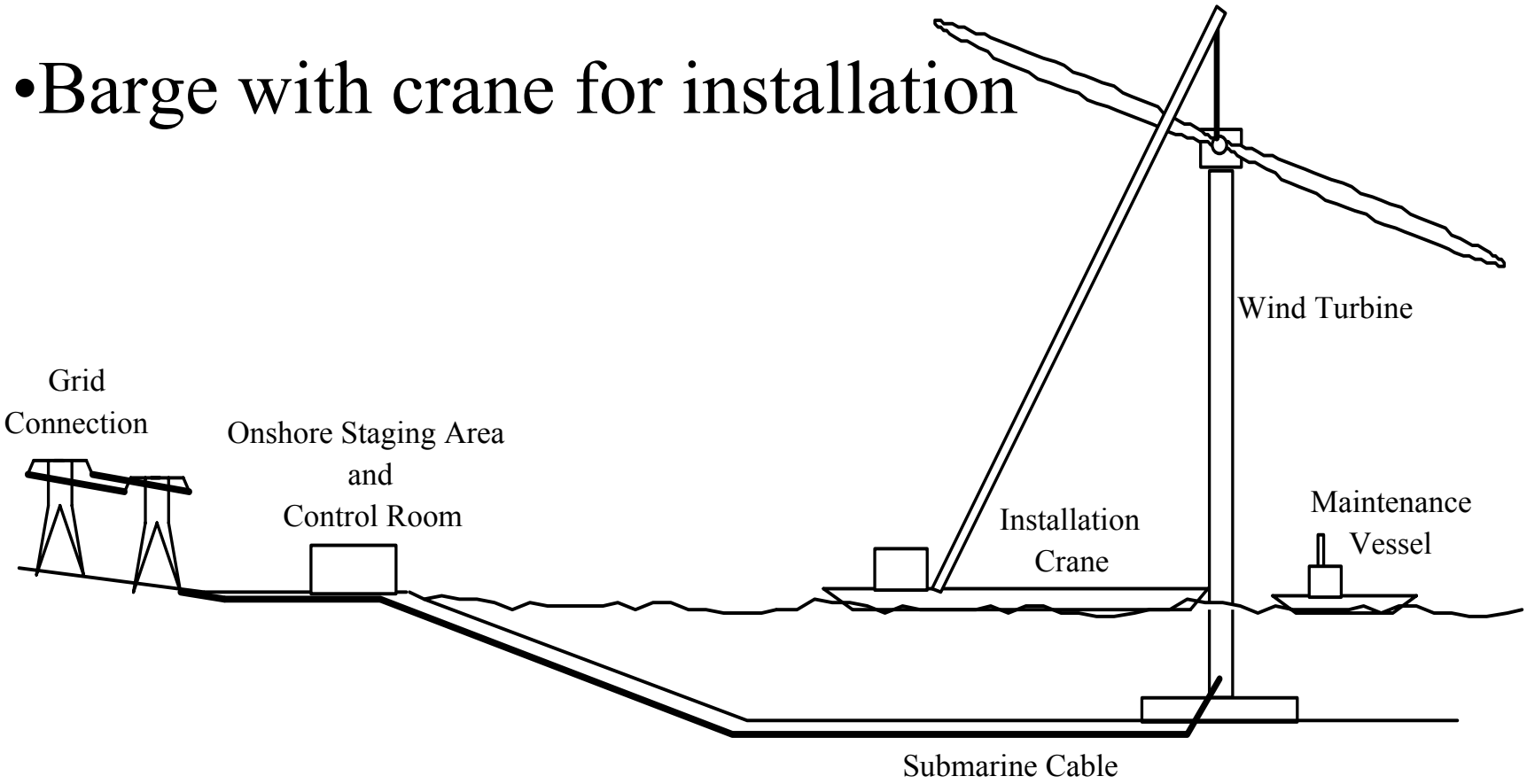
Conceptual Design of Typical Offshore Wind Plant

- Submarine cable to mainland for power and communication



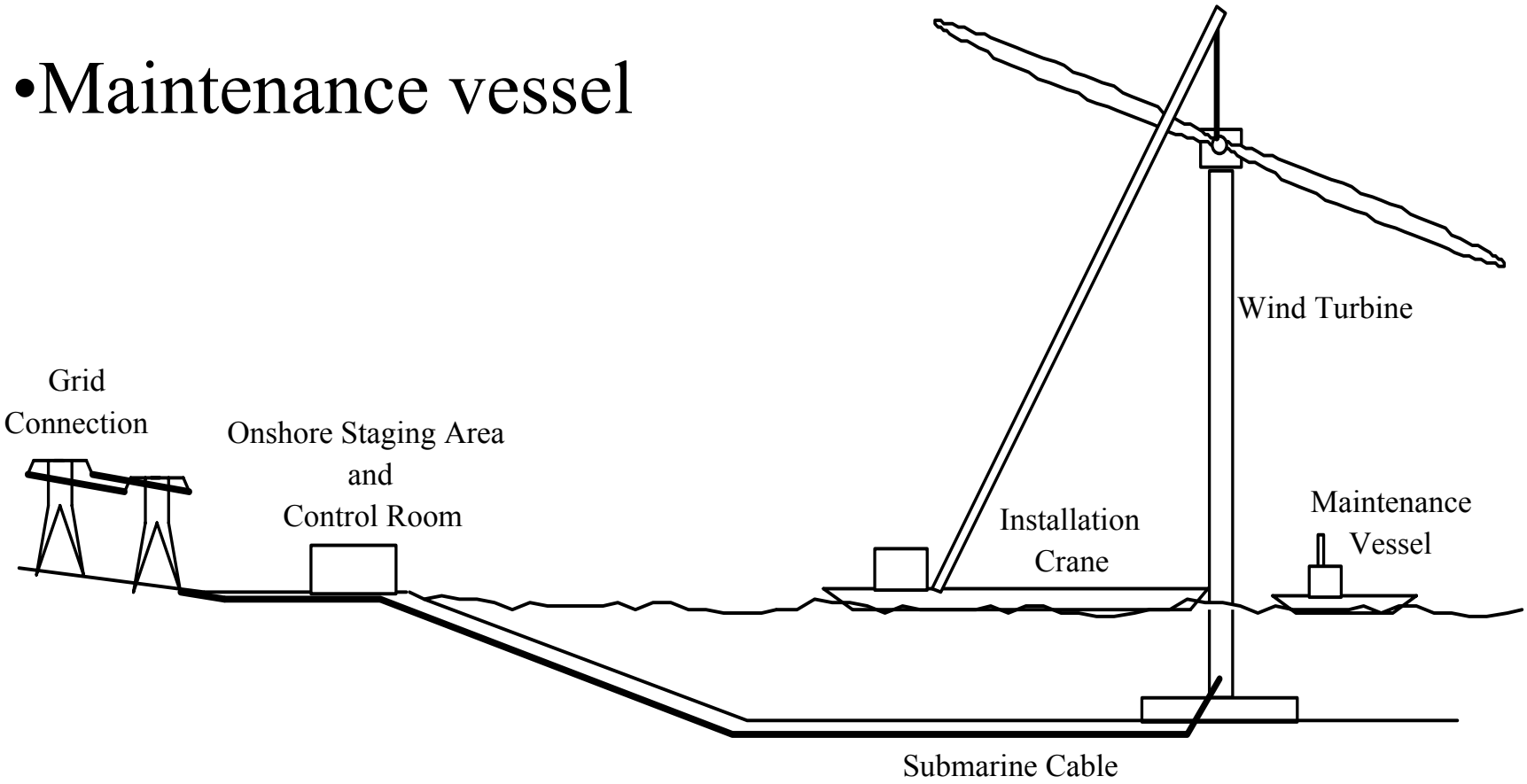
Conceptual Design of Typical Offshore Wind Plant

- Barge with crane for installation



Conceptual Design of Typical Offshore Wind Plant

- Maintenance vessel



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Why the Interest?

- Land use constraints onshore
- Higher winds than onshore
- Vast potential area and energy
- Lower turbulence
- Proximity to major load centers

European Experience with Offshore Wind

- First offshore wind farm 1991, 5 MW
- Largest project now 40 MW
- Major projects planned for Denmark, Germany, Sweden, Netherlands
- Plans for 4000 MW in Denmark by 2030

Example: Wind Farm Off Copenhagen, Denmark

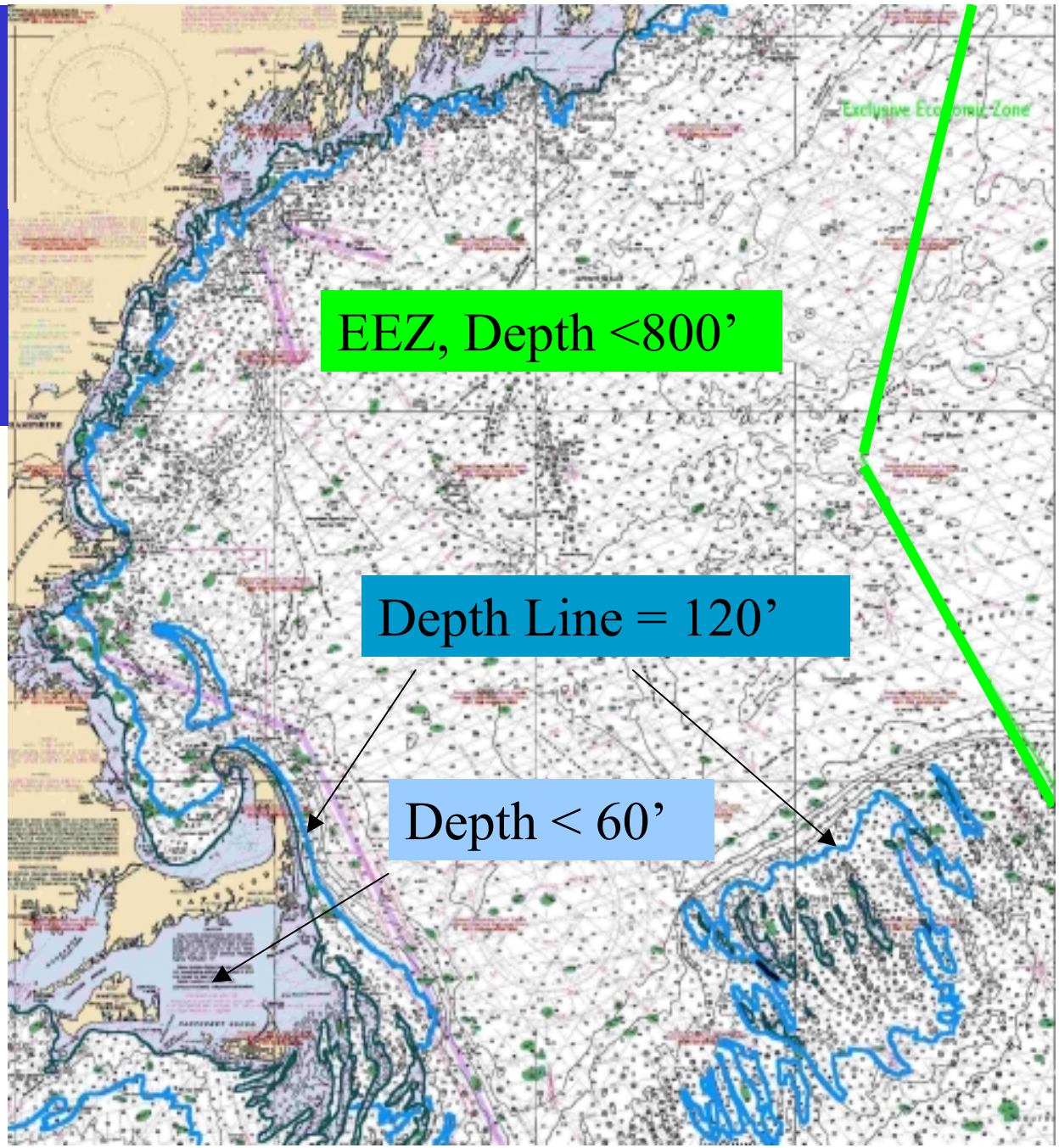
- 20 x 2 MW
- ~ 1 mile offshore

View from sea →

Panoramic view

Water Depths Off New England

- Significant area with near term commercial potential
- All of Exclusive Economic Zone (EEZ) conceivable for moored floating systems



Technical Issues for Offshore Wind Development in New England

- Wind resource
- Extreme winds
- Waves
- Foundation designs for shallow water
- Floating structures for deep water
- Power transmission

Offshore Wind Economics

- Cost of Energy now ~$0.04-0.09/kWh
- Costs affected by:
  - Mean wind speed
  - Site conditions
  - Distance from shore
  - Project size
- Floating systems presently estimated to cost ~$0.10/kWh

Economic Impacts

- Capital intensive
- Local job creation in maritime industry
- Potential significant impact on utility fuel purchases and energy costs

Typical Economic Activity

Loading blades during construction of Utgrunden, Sweden, offshore wind farm

Conclusions (1)

- Offshore wind is a reality in Europe
- Wind turbine manufacturers have capability and interest in offshore wind energy
- New England has large offshore wind resource
- New England has long history in conceptualizing offshore wind energy development

Conclusions (2)

- Significant technical development required to reduce costs
- Floating systems technically feasible; extensive development required
- Siting issues are significant but appear solvable
- First U.S. offshore project remains to be developed